IDENTIFYING CRITICAL BARRIERS AND DRIVERS FOR GREEN SUPPLY CHAIN MANAGEMENT APPLICATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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IDENTIFYING CRITICAL BARRIERS AND DRIVERS FOR GREEN SUPPLY CHAIN MANAGEMENT APPLICATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY

by

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11 MP	Eleventh Malaysia Plan
CIDB	Construction Industry Development Board
CITP	Construction Industry Transformation Programme
CO_2	Carbon Dioxide
EMS	Environmental Management System
FMM	Federation of Malaysian Manufacturers
GBI	Green Building Index
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GSCM	Green Supply Chain Management
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
LIT	Lifecycle Impact Tool
MARA	Majlis Amanah Rakyat
MEGTW	Ministry of Energy, Green Technology and Water
MGBC	Malaysia Green Building Confederation
NGTP	National Green Technology Policy

SCM	Supply Chain Management
SCP	Sustainable Consumption and Production
SIRIM	Scientific and Industrial Research Institute of Malaysia
SME	Small and Medium-Sized Enterprise
UNEP	United Nations Environmental Programme

PENGENALANPASTIAN PENGHALANG DAN PEMANDU KRITIKAL UNTUK PENGURUSAN RANTAIAN BEKALAN HIJAU DALAM INDUSTRI PEMBINAAN DI MALAYSIA

ABSTRAK

Industri pembinaan merupakan salah satu penyumbang utama kepada pencemaran dan pemanasan global. Aktiviti pembinaan yang semakin meningkat telah meneroka sebahagian besar sumber semulajadi dan menyebabkan kemerosotan ekologi yang mendatangkan kesan-kesan buruk terhadap bumi, manusia, persekitaran serta kehidupan lain. Banjir kilat, kemarau panjang, ketidaktentuan corak cuaca, hujan dan ribut petir yang sukar diramalkan telah menjadi kebimbangan utama di Malaysia. Pengurusan rantaian pembekalan hijau (GSCM) adalah integrasi antara kesedaran alam sekitar dengan pengurusan rantaian pembekalan konvensional telah mula menarik perhatian pelbagai pihak di mana isu pencemaran dan pemanasan global dititikberatkan. Walaubagaimanapun, inisiatif hijau terutamanya dalam industri pembinaan di Malaysia adalah konsep yang amat baharu dan tidak dikembang sepenuhnya. Tambahan pula, kajian dan informasi terhadap GSCM di industri pembinaan adalah amat terhad dan tidak lengkap. Oleh itu, terdapat kekurangan pengetahuan dan penemuan corak pengurusan hijau di pasaran tempatan disebabkan oleh belum berlaku proses pemindahan maklumat dari luar negaradan industri lain. Justeru itu, okjektif kajian ini adalah untuk mengenalpastikan tahap pelaksanaan GSCM di industry pembinaan di Malaysia serta penghalang dan pemandu kritikal dalam pelaksanaan GSCM. Okjektif pertama dalam kajian ini adalah untuk menyiasat tahap pelaksanaan GSCM di industri pembinaan. Selanjutnya, pengenalpastian faktor-

faktor penghalang dan pemandu juga merupakan objektif kajian. Analisis akan dijalankan atas hubungan antara penggunaan GSCM, penghalang dan pemandu. Dalam kajian ini kaedah kuantitatif telah digunakan iaitu dengan soal selidik (melalui pos dan e-mail). Populasi responden kajian ini ialah G7 syarikat kontraktor di Pulau Pinang, Wilayah Persekutuan dan Johor. Empat ratus lima puluh borong soal selidik telah diagihkan dengan kadar maklumbalas sebanyak 21.8%. Data dianalisiskan mengguna *SPSS Statistical Software*. Keputusan menunjukkan tahap pelaksanaan GSCM adalah rendah terutamanya bagi *'Investment Recovery'*. Kebanyakan kontraktor berpendapat bahawa pelaksaaan GSCM tidak berkaitan dengan inisiatif GSCM dan mereka tidak melaksanakannya. Manakala sebahagian besar kontraktor berkerjasama dengan klien dalam proses pembinaan. Lebih 25% kontraktor menggunapakai praktis *'Cooperation with Customers'* lebih daripada setiap kali dan melaksanakan bagi projek mereka. Secara amnya, inisiatif GSCM dalam bidang pembinaan masih kurang popular dan pelaksanaannya masih ditahap rendah. Selain itu, *'Government Supports'* dan *'Company Resources'* merupakan faktor penghambat utama dalam praktis *'Green Design'*. Manakala untuk pendorong, faktor *'Regulations'* adalah signifikan terhadap *'Internal Environmental Management'* dan faktor *'Competitiveness'* bersignifikan terhadap praktis *'Cooperation with Customers'*. Dalam industri pembinaan Malaysia, GSCM masih dianggap baru dan tindakan seterusnya perlu diambil untuk mewujudkan sebuah persekitaran yang selamat dan bersih.

IDENTIFYING CRITICAL BARRIERS AND DRIVERS FOR GREEN SUPPLY CHAIN MANAGEMENT APPLICATION IN THE MALAYSIAN CONSTRUCTION INDUSTRY

ABSTRACT

The construction industry is a major contributor to both global pollutions and global warming. Booming construction activities consume large amount of natural resources and cause degradation of ecology, eventually result in an adverse impact to our earth, human beings, natural environment and other living creatures. Devastating floods, annual dry spells, irregular weather patterns as well as unpredictable storms have become major concerns in Malaysia. Green Supply Chain Management (GSCM), which is the integration of environmental thinking into the supply chain management has started to gain attention from many parties as they are increasingly aware of the global pollution issues. In Malaysia, green initiatives especially in construction, are new and at the infancy stage. Besides that, studies on GSCM in construction industry are limited and not much information are found to discuss the application of GSCM in construction process when this research is carried out. Therefore there are lack of knowledge and lack of discoverable green management pattern in local market as the relevant knowledge is yet to be transfered from other industries or countries to Malaysia. Thus, this study aims to identify the level of adoption of GSCM in the Malaysian construction industry as well as analyse the critical barriers and drivers of GSCM adoption. Investigation of adoption level of GSCM application in construction industry is the first objective of this study. Moreover, identifications of barriers and drivers of GSCM implementation are the other objectives. Likewise, this study also

investigates the relationship between the adoption of GSCM, barriers and drivers of GSCM initiatives. Quantitative research method is adopted in this study with survey questionnaire (by post and email). The population of this study is set to be G7 contractor companies in Penang, Wilayah Persekutuan and Johor. Approximately 450 questionnaires are distributed to the respondents with the response rate of 21.8%. The collected data is analysed with SPSS Statistical Software. Results shows that the adoption level of GSCM initiatives in construction industry are still low especially for the 'Investment Recovery' practice. Most of the contractors share the same opinion that 'Investment Recovery' practice is not relevant to GSCM initiatives and they do not implement it. While large number of contractors cooperate with their customers during the construction projects. More than a quarter of the contractors adopt 'Cooperation with Customers' practice more than once as well as implement it every time in their projects. In overall, the GSCM initiatives in construction industry are yet so popular and adoption level is still very low. Furthermore, for the adoption barrier, the 'Government Supports' barrier and 'Company Resources' barrier are the main barriers for 'Green Design' practice. While for the adoption drivers, the 'Regulations' driver is significant to 'Internal Environmental Management' practice while 'Competitiveness' driver is another vital driver for 'Cooperation with Customers' practice. In a nutshell, GSCM practices are still new for the Malaysian construction industry and more actions should be taken in order to provide a safer and greener construction industry.

CHAPTER 1

INTRODUCTION

1.1 Background of the Research

Environmental degradation is an undisputable fact due to growing human and industrial impacts. In recent decades, environmental issue becomes a foremost global concern, suchlike global warming and ozone depletion which emerge as major pollution issues. The environmental pollution issues are greatly caused by various construction activities (Chan & Chan, 2004). It causes the reduction and exhaustion of non-renewable resources, devastation of landscapes as well as occurrence of safety and health problems to the human being (Klufallah, Nuruddin, Khamidi, & Jamaludin, 2014). According to United Nations Environmental programme (UNEP) in 2007, 30% of the global total greenhouse gases (GHGs) has been produced from the construction industry (Balasubramanian, 2012).

Studies found that one-third of the carbon dioxide (CO_2) emission worldwide is contributed by concrete jungle (Melanta, Miller-Hooks, & Avetisyan, 2013; Chua & Oh, 2011). 45% to 50% of global resources is used in erecting buildings and 80% of agriculture lands is lost to accommodate human being (Willmott Dixon, 2010). Besides that, about 70% of natural habitats, flora and fauna on the surface of earth is predicted to be destroyed due to the development of the built environment by 2032 (UNEP, 2003; Green24, n.d.). In addition, building materials manufacture and

transportation, plant and machines' energy consumption, resources process energy consumption as well as construction waste disposal are four main sources of GHGs emission in construction industry (Buchanan & Honey, 1994). Figure 1.1 illustrates the consumption of energy and emissions of GHGs of building sector.

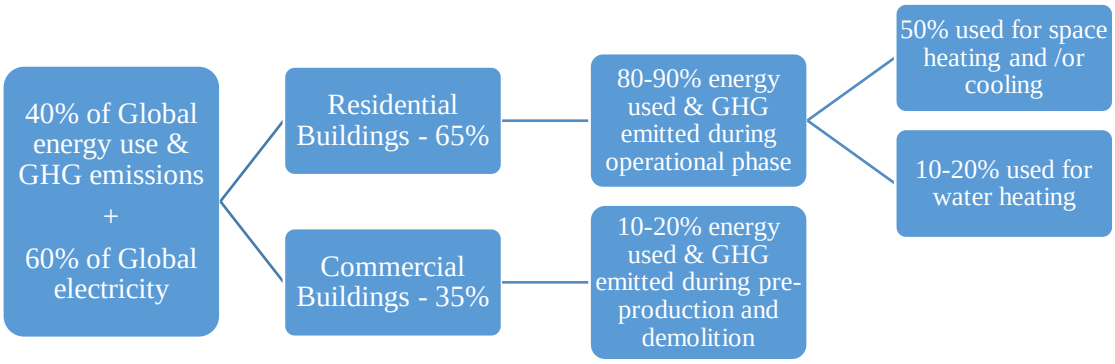

Figure 1.1 Global Contribution of Building Sector to Climate Change (Zaid, Myeda, Mahyuddin, & Sulaiman, 2015)

About 23% of global construction activities are taken up by developing countries (Bohari et al., 2015). Malaysia as one of the developing countries, is experiencing rapid construction growth. Malaysia is targeted to become a 'high-income economy' by 2020 from current 'upper-middle-income economy' (Bohari & Bo, 2015). Unfortunately, statistics show that about 24% of CO_2 from total CO_2 emissions come from construction industry in the country (Samad, Rahman, & Ibrahim, 2008). Safaai et al. (2010) found that carbon dioxide (CO_2) emissions of Malaysia in 2020 tend to amount to 285.73 million tonnes, which is 68.86% hike compared to year 2000.

Even though the matter of environment protection has been introduced in Malaysia since 1960s, however the green concepts only get attention in recent and has

turned into the core of focus among Malaysian construction stakeholders (Bohari et al., 2015). The flow of green supply chain management is shown in Figure 1.2.

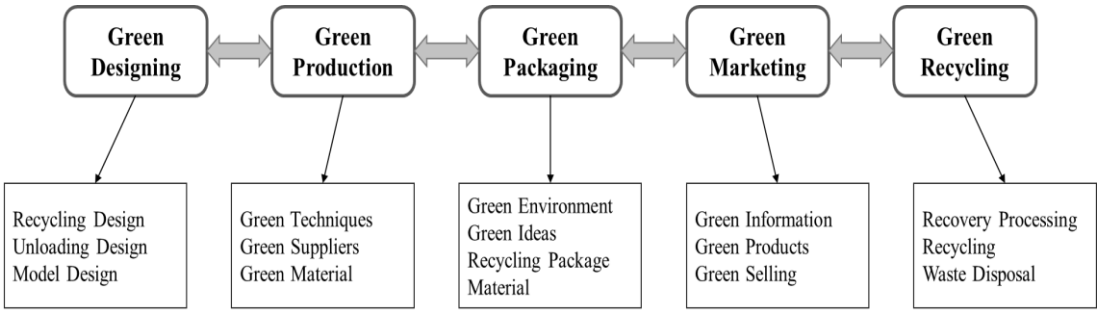

Figure 1.2 Green Supply Chain Management's Flow (Shi, 2009)

In addition, Malaysia Environmentalism faces three waves from 1900 until today. Nature Protection for instances nature conservation, pollution control and adversarial advocacy were the first wave (1900-1980s), Governmental Reform such as supra-structures, new instruments and Agenda 21 were the second wave (1990s-2005) and the third wave (2006-present) focuses on green investment which includes low carbon growth, energy switch and technology localisation (Hezri, 2011). Figure 1.3 presents the three waves of environmentalism in Malaysia.

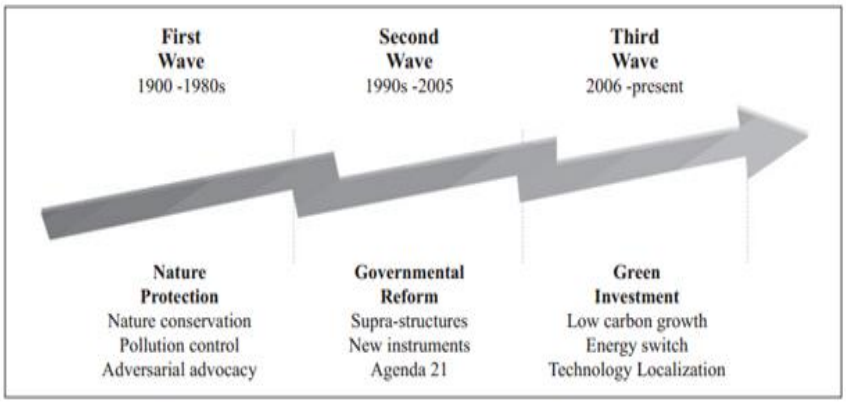

Figure 1.3 Three Waves of Environmentalism in Malaysia (Hezri, 2011)

Green Supply Chain Management (GSCM) is found to be an innovative strategic tool that can stimulate both environmental and financial performance at the same time (Srivastava, 2007). Generally, Zhu and Sarkis (2004) presented that the scope of GSCM is from green purchasing to integrated supply chain and reverse logistic, the involved parties may from supplier, to manufacturer as well as to customer. The main flow of GSCM is shown as Figure 1.2. The green supply chain management concept becomes more essential as the contribution towards eco-efficiency (Govindan et al., 2014), sustainability (Yusuf et al., 2013; Zhu, Sarkis & Lai, 2013) as well as future operations management (Gunasekaran & Ngai, 2012; Diabat & Govindan, 2011). Presently, the practical guideline for stakeholders to procure green project is still inadequate and the concept of GSCM such as green procurement is still fresh to Malaysian construction industry (Bohari & Bo, 2015).

In 2015, Datuk Dr. Judin Abdul Karim, the chief executive of Construction Industry Development Board (CIDB) Malaysia, mentioned that sustainable construction is the game changer for construction industry under the Eleventh Malaysia Plan (11MP) 2016-2020 at Zofnass Programme Symposium at Harvard University in United State (Chai, 2015).

Statistics shows that 29,435 construction projects have been awarded with a total value of RM 470 billion from 2011 to 2014 (CITP, 2017) and this indicates that construction industry is a key economic driver in Malaysia. Additionally, Construction Industry Transformation Programme (CITP) was launched in September 2015 as a part of the '11MP' with a determined goal to motivate Malaysia's sustainable construction as a global model. Malaysian construction industry has to grow and embrace international standards for contemporary, well-organised and sustainable practices

such as Environment Management System (EMS) ISO 14001 in order to make sure a truly developed nation (Chai, 2015).

1.2 Problem Statement

Construction industry plays an active role in socio-economic development of any countries around the world. Especially for developing countries, construction industry is important in contributing in Gross Domestic Product (GDP) as well as providing job opportunities. Over the last twenty years, 3% to 5% of national GDP of Malaysia is steadily contributed by construction industry (Johnston, Everard, Santillo & Robert, 2007). Unfortunately, the construction industry has caused destructive effects to the environment from waste generation, water and resources depletion, as well as other forms of damage to environment (Aigbavboa, Ohiomah & Zwane, 2017).

The unsustainable construction activities and processes have caused various irretrievable effects to the environment, social as well as economics. Study found that construction industry is one of the major contributors of environmental pollutions (Chan & Chan, 2004). The statistics from UNEP 2007 show that construction industry consumed 3 billion tonnes of raw materials, produced 10-40% of solid wastes and created 30% of global GHGs yearly (UNEP, 2007). Elbarkouky and Abdelazeem (2014) mentioned that construction industry is responsible to review the sustainability and the environmental performance of their projects.

Sustainable construction emphasizes on the energy conservation, water preservation and natural resources protection by reusing, recycling, innovative design

and also waste and pollution minimisation in order to meet the future demands without jeopardising the needs of our future generations (Suliman & Omran, 2009).

One of the major parts of the Government's policy on Sustainable Development is to promote sustainable construction, which distinguishes that our economy, environment and social well-being are mutually dependent (Lim, 2015). In Malaysia, the government has been promoting sustainability initiatives since year 2000 (Lim, 2015). Unfortunately, not more than 2% of qualified construction projects are evaluated with sustainable building rating systems for example Green Building Index (GBI) in Malaysia according to CIDB statistics 2014-2015. For those assessed projects, less than 50% have been rated with satisfied GBI. The statistics and details of GBI rating project is shown in Figure 1.4.

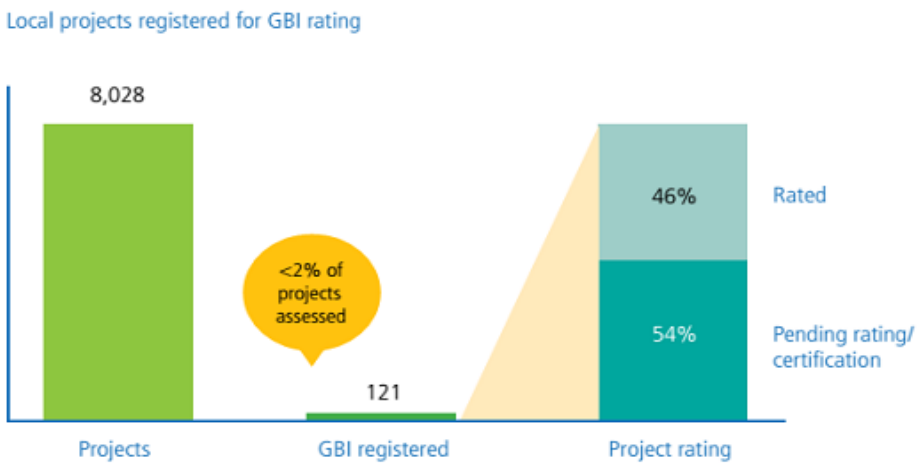

Figure 1.4 The Percentage of Projects Registered with GBI and GBI Rated Projects (CIDB, 2015)

Green Supply Chain Management (GSCM) is an advanced strategic tool that can promote environmental and financial performance simultaneously. Previous studies found that green supply chain management (GSCM) plays active roles in

improving firm's economic, environmental as well as operational performances in various industries such as automotive, manufacturing, construction, electrical and electronic (Florida, 1996; Frosch, 1994; Geffen & Rothenberg, 2000; Hanna, Newman & Johnson, 2000; Bowen et al., 2001; Rao & Holt, 2005; Vachon & Klassen 2006; Zhu & Sarkis, 2007; Zhu, Geng, Fujita & Hashimoto, 2010; Green et al., 2012). Hence, GSCM is a possible tool that could achieve sustainability in the construction industry.

Yet, firms in Malaysia are still in the learning stage of sustainable practices and the gap does exist between awareness and adoption of green strategies (Hajikhani, Wahiza & Idris, 2012). Apart from that, Zulkefli, Zainudin and Azlan (2014) mentioned that the implementation level of GSCM in Malaysian construction industry remains at the development stage. In a nutshell, a lot of challenges may be faced and suitable policy needs to be implemented in the form of an executive order by CEO, governor or public leader (Pearce, Yong & HanmiGlobal, 2012).

Last but not least, there are several gaps of research that need to be filled up in this study. Three research gaps are illustrated as Figure 1.5.

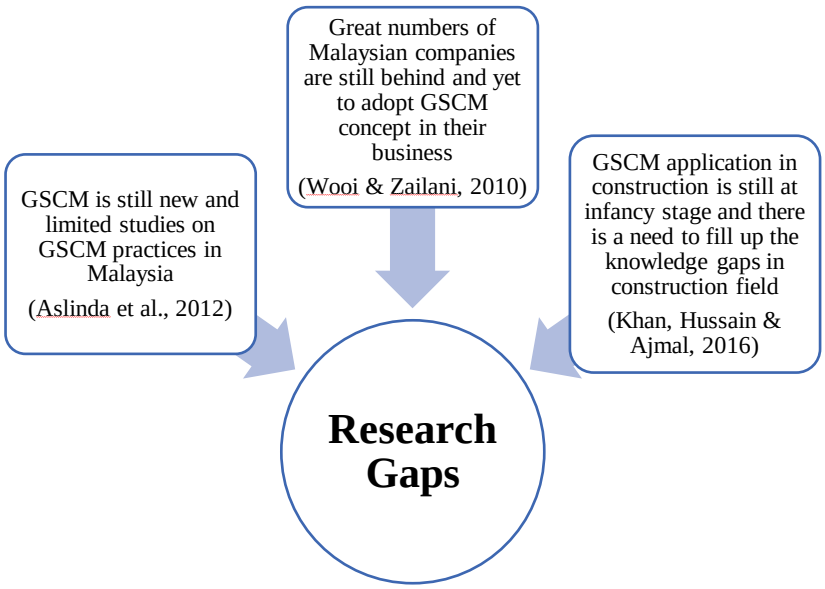

Figure 1.5 The Gaps of Research

1.3 Aim of the Study

This research is designed to determine the adoption level of GSCM in construction industry. Although some studies on barriers analysis were carried out by Goh and Zailani (2010) in Malaysian SMEs and Chine automobile industry by Zhu et al. (2007), but the opinions about GSCM adoption are diverse in different industries, therefore study needs to be carried out to identify the critical barriers in Malaysian construction industry. In addition, some pressures or drivers for GSCM application in construction also need to be determined such as customer's demand, competitive pressure as well as policy implementation from different stages of project like feasibility stage, design stage, construction stage and so on (Hajikhani et al., 2012).

1.4 Research Questions

Based on the problem statement, there are four (4) research questions for this study that need to be answered:

i.) What is the level of adoption of GSCM application in the Malaysian construction industry?

ii.) What are the critical barriers of GSCM adoption in the Malaysian construction industry?

iii.) What are the effective drivers to encourage the implementation of GSCM application in the Malaysian construction industry?

iv.) What is the relationship between implementation level of GSCM and its critical barriers and effective drivers in GSCM adoption?

1.5 Research Objectives

Referring to the questions of the research, several objectives are developed to support this research, which are:

i.) To investigate the level of adoption of GSCM application in the Malaysian construction industry.

ii.) To determine the critical barriers to adopt GSCM application in the Malaysian construction industry.

iii.) To identify the effective drivers to encourage the GSCM implementation in the Malaysian construction industry.

iv.) To find out the relationship between implementation level of GSCM and its critical barriers and effective drivers in construction industry.

1.6 Scope and Limitation of the Study

This study focuses on the construction industry in Malaysia. There are many different grades of contractor companies in the Malaysian construction industry, which are grade G1 to grade G7. This study is concerned on the grade G7 contractor companies, while the G1 to G6 companies are excluded in this study. Furthermore, various GSCM practices have been discovered from previous study, nevertheless not all GSCM practices are focused in this study, only few practices are covered, such as green design, green purchasing, investment recovery, internal environmental management and customers cooperation. Next, construction industry is unique as it comprises multidisciplinary professionals due to the complexity of construction project, this

study only covers the professionals from the G7 companies and excludes other stakeholders in the construction project.

The limitation of this study is that the environment where the respondents give answers to the survey questions is difficult to be controlled for quantitative study. Self-reported information might be obtained from the questionnaire and there is tendency for it to be inaccurate or incomplete. Another limitation is that extra resources are required to analyse the results. Several analysis methods need to be carried out when there are uncertainties, ambiguity or discrepancies in the results. Hence, additional capitals, time, resources and supports are essential in order to retest and refine the result outcomes.

1.7 Significance of the Study

An effective and practicable management of construction green supply chain is vital to attain the performance of the project in term of economic, environmental, operational and also social performance. This research aims to offer some merits for construction players such as contractors, developers, employers and professionals within the contractor's firm by GSCM adoption which provides a better understanding of GSCM to cope with current unusual environmental issues, understands the problems and obstacles faced by the construction players in adopting the GSCM and provides some suitable drivers to promote GSCM adoption in construction industry.

Firstly, this research can provide a better understanding of GSCM to the contractors, developers as well as professionals in the contractor's firm in the increasing environmental concerns in construction industry. Different GSCM practices

like green purchasing, green design/eco-design, green procurement, internal environmental management and reverse-logistic can mitigate the environmental burden and resource scarcity in various degrees.

Secondly, the acceptance and adoption of GSCM in construction are still low despite enormous benefits of it. This study is able to highlight some principal problems faced by the construction players in GSCM implementation in construction together with some usable drivers to motivate those construction players. In short term, the effects of GSCM in construction may not be visible. However, the contribution of GSCM to environmental can be observed in the near future.

Last but not the least, the studies on GSCM in construction industry are still limited and yet done widely in Malaysia. The pertinent knowledge of GSCM from other countries or other industries is yet to transfer to the Malaysian construction industry and thus there are lacking of supportive studies and evidence to proof the success of GSCM application. Consequently, this study can act as one of the references for future studies in the related area.

1.8 Research Methodology

Regarding to the study of barriers and drivers identification for GSCM adoption in Malaysian construction industry, the research process assigns into four (4) stages, preliminary study stage, research planning stage, data collection and analysis stage and conclusion stage.

Stage one (1): In the preliminary study stage, the area of study is evaluated which is the GSCM in construction industry and some current issues in

the supply chain management are identified after reviewing some of the related literatures. From the literature review session, some related articles, journals, books and reports from the previous works are revised. Accordingly, the problem statement is then formulated in this stage.

Stage two (2): The aim and objectives of the study are established in this stage. Some questions also appear according to the objectives of the study which are required to be answered in the finding of this study. At the same time, the scope of the study is narrow to the building industry and the construction players are limited to contractors and professionals such as architect, engineer and quantity surveyor. The significance of study is also determined in this stage. Lastly, the data collection instrument is developed.

Stage three (3): In the stage of data collection and analysis, the quantitative survey method is adopted. The data is collected through questionnaires survey (quantitative) by postal and email ways and then follow up by phone call. After the data cleaning and screening process, the cleaned data is analysed by using the SPSS statistical analysis software. In the later part of this stage, the results of the analysis are discussed.

Stage four (4): As a final point, the conclusion is drawn together with some recommendations for possible further studies.

The flow of the research methodology is illustrated as Figure 1.6.

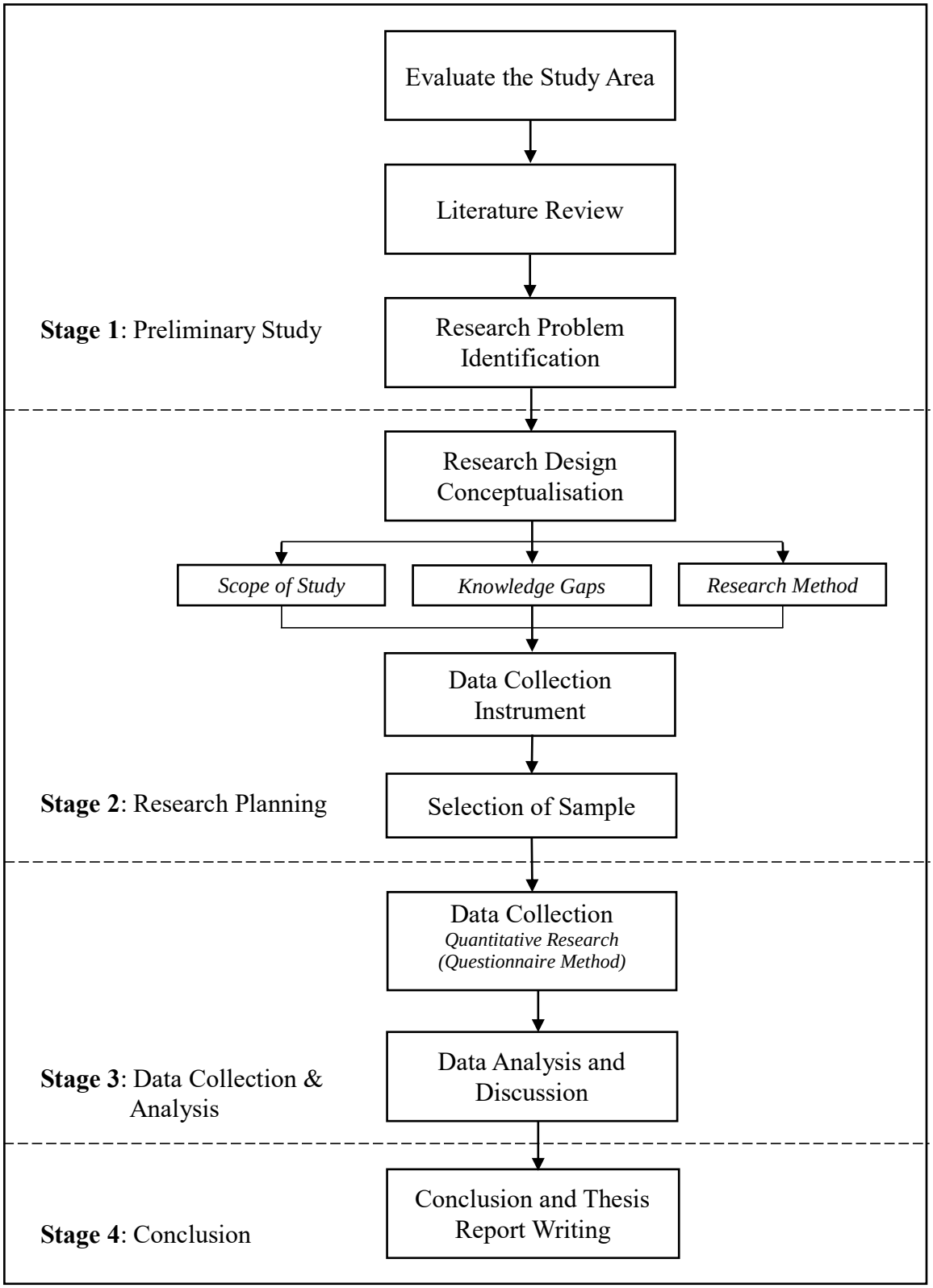

Figure 1.6 The Flow of Research Methodology (Adapted from: Kumar, 2011)

1.9 Thesis Outline

This thesis is structured into six (6) chapters. An overview of contents of each chapter is briefed as follow:

Chapter 1 is begun with the background of the study and continued by the problem statement of the study. The aim, questions and objectives of the research, scope of the study, significance of the study and research methodology are parts of the chapter. Lastly, this chapter is ended with the thesis outline sub-chapter.

Chapter 2 is one of the influential parts of the study as it may affect the study's outcomes, which is literature review part. It is important to review the previous studies and works in the related field for the purpose to establish theoretical framework of the study. In this chapter, the current issues and challenges in Malaysian construction industry are reviewed and some efforts of government in greening the construction activities and processes are also covered. Moreover, the application of Green Supply Chain Management (GSCM) is discussed, drivers and barriers of GSCM adoption are reviewed, organisational theories related to GSCM application are briefly explained and finallyy the knowledge gaps in Malaysian construction industry are determined.

Chapter 3 reports the research methodologies of this study. Quantitative method research is adopted. Quantitative data is collected with questionnaire survey technique. Subsequently, population sampling, size of sample, data analysis methods, data validity and reliability are described in this chapter.

Results and outcomes of analysis are comprised in chapter 4. Reliability and normality tests are carried out before proceeding to next part of analysis. After passing the reliability and normality tests, the level of adoption of GSCM practices are

determined. Furthermore, the adoption level of GSCM practices are further discussed according to each practice, which are Green Design, Green Purchasing, Investment Recovery, Internal Environmental Management and Cooperation with Customers. For the latter part of analysis, the adoption barriers and drivers of GSCM are analysed by its relative weights. Last but not the least, multiple regression and Pearson correlation analysis techniques are carried out to identify the relationship between GSCM practices and its implementation barriers as well as drivers.

Chapter 5 is the findings and discussion chapter which consists of explanations, discussion and justification of results from Chapter 4. Some previous works that are related to this research are also referred when discussing the result outcomes of this study. Moreover, a summarisation of the main finding of this study is included in order to have an easy understanding of the study outcomes.

Conclusion and recommendations chapter is the last chapter of this study, which is Chapter 6. A conclusion of the study is drawn as a closing of this research. In addition, some recommendations for further study are suggested.

1.10 Summary

Generally, this chapter underlines the research background and gaps that are related to construction industry and provides the overview of the study. Four research objectives are formulated from the research questions. Furthermore, the scope and significance of the study are also discussed in this chapter. This chapter also presents the research methodology of the study as well as the outline of whole thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is the literature review chapter which reviews the previous works related to green supply chain management (GSCM) approach in construction industry as well as other industries. GSCM is the new idea of supply chain management which can mitigate the environmental pressure resulted from human activities. Some concerns and challenges in Malaysian construction industry are also briefly discussed under this chapter. Moreover, some organisational theories related to GSCM, activities and practices of GSCM, barriers as well as drivers of GSCM implementation are also reviewed and discussed in this chapter.

2.2 Scenarios and Challenges in Malaysian Construction Industry

As one of the developing countries, the flourish of construction activities and large-scale land development in Malaysia have caused destructive residues to environment and human beings. More and more pressure will be created on the environmental situation of Malaysia if construction projects are continuing to deliver in current way which is unsustainable (Bohari et al., 2015). Even though sustainable building and infrastructure developments are desired by the Malaysian government with establishing policies in green procurement and strategic planning as support.

Unfortunately, the research on green building procurement arrangements and strategies is still limited.

2.2.1 Efforts to Mitigate Climate Change

A lot of efforts and endeavours have been put by the government in mitigating the environmental pollutions and climate change caused by the country development activities especially in construction field. National Green Technology Policy, MyHIJAU programme and Construction Industry Transformation Programme are some sustainable policy and programmes in recent years.

National Green Technology Policy (NGTP) was launch in 2009 and the Ministry of Energy, Green Technology and Water (MEGTW) is leading the Malaysia green technology agenda which focuses on energy conservation, technology localisation, low carbon development, environment conservation, public education enhancement and green technology consciousness (MEGTW, 2010). In order to support the dissemination of green technology and development particularly in construction industry, the Green Technology Financing Scheme was initiated in 2009 to promote green concept in Malaysian construction industry (Shafie, Mahlia, Masjuki & Andriyana, 2011).

In 2012, MyHIJAU programme has been introduced by Ministry of Energy, Green Technology and Water and Ministry of Finance with the collaboration with Malaysia's research and standards development organisation (SIRIM) to launch a green procurement guide, procedures and standards, a certification and labelling mechanism to ease the management of green purchasing in the public as well as private

sectors (Bohari & Bo, 2015). In addition, The National Sustainable Consumption and Production (SCP) Policy framework was produced as the SCP Blueprint and involved in the 11th Malaysian Plan (11MP), 2016–2020. Figure 2.1 exemplifies the milestone of MyHIJAU.

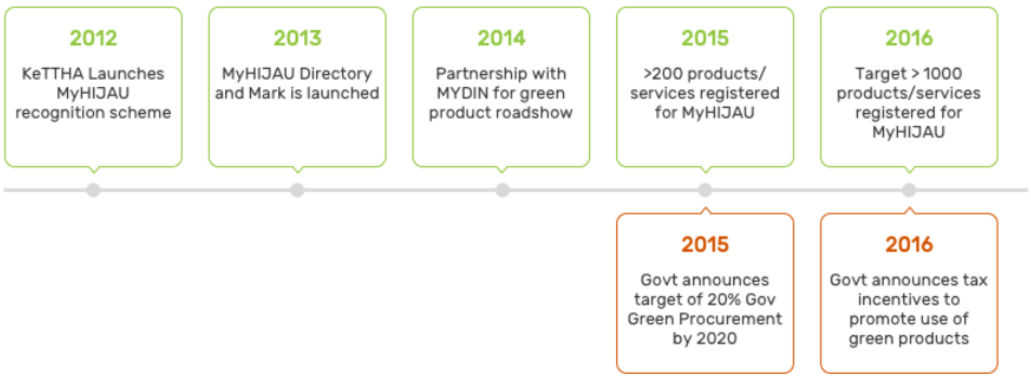

Figure 2.1 Milestone of MyHIJAU (Source: https://www.myhijau.my/about/)

Likewise, Construction Industry Transformation Programme (CITP) was September 2015. It is a five-year national agenda (2016-2020) which aims to transform the Malaysian construction industry to an industry with high productive, environmental sustainability, good safety and quality standards (CITP, 2017).

Four (4) strategic thrusts of CTIP help and guide the construction industry to transform and develop continuously for the purpose to bump into the future economic demands of the country (CITP, 2017), which are;

i. Quality, Safety and Professionalism
ii. Environmental Sustainability
iii. Productivity
iv. Internationalisation

Four strategic thrusts of CITP 2016-2020 is shown as Figure 2.2.

Figure 2.2 Four (4) Strategic Thrusts of CITP 2016-2020

2.2.2 Road towards Green Construction

In order to achieve sustainable development, green construction is engaged by construction industry which targets to minimise the overall effect on the natural environment (Bohari et al., 2015; Bourdeau, 1999). Green construction intents to decrease the GHGs emissions, reduce the level of pollutants, promote reuse and renewal approaches to conserve natural resources and reduce wastes throughout every stages of construction projects.

Reducing of the environmental impact and influence of a building throughout its lifespan and offer comfortability, safety and welfare of the residents/occupants without overlooking economic viability are the main goal of green construction (Isover, 2009; Abidin, 2009; Aguilar, 2008). In short, green/sustainable construction is an advanced construction technology which encompasses inclusive management (Qi, Shen, Zeng & Jorge, 2010; Tam, Tam, Zeng & Chan, 2006).

Besides that, there are some differences between green construction practices and standard building practices. For example, sustainable construction practices

highlight on long-term affordability, quality and efficiency while standard building practices emphasize on short-term monetary concerns (Isover, 2009).

Unfortunately, there are some differences between the terms “green” and “sustainable”. “Green” is linked with different ideas like energy efficient while “sustainable” aims to create environmentally-friendly services and products (Suliman & Omran, 2009; Shelbourn et al., 2006). Nonetheless, sustainable construction also known as green construction that being implemented sustainability into construction industry (Abidin, 2009).

2.2.3 Desire for Green Buildings

Kibert (2012) defines green building as:

“The end product must be able to reduce the overall impact on the natural environment by reducing greenhouse emissions, conserving resources through reuse and renewal strategies and reducing waste”.

With green building concept, efficiency of resources such as energy, water and materials can be improved as well as impacts of building on both human and environment can be reduced during the lifecycle of buildings with better building design, construction, operation, maintenance and demolition and removal (Chua & Oh, 2011).

In April 2009, Malaysia Green Building Confederation (MGBC) was registered with an objective to be the front-runner in green building in Southeast Asia (MGBC, 2017). At the same time, MGBC also aims to become the leading supporter

as well as promoter of green and sustainable practices as well as the main sustainability reference organisation within the rising of construction market industry.

MGBC targets to transform the construction industry into the environment that embracing with green issues by energy saving, water conservation, better indoor and outdoor quality, well public connectivity and establishment of greenery in development with involving all construction players such as policymakers, professionals and society at large (Chua & Oh, 2011). Additionally, the significant roles of MGBC are:

i. Cooperate and upkeep the government and construction industry in developing a sustainable built environment,
ii. Ease of knowledge sharing in the sustainable built environment field,
iii. As a reference hub for sustainable and green building resources,
iv. As a nationally and internationally platform for networking on sustainability matters,
v. Stimulate and promote the anxieties for sustainable buildings
vi. Support, encourage and offer input to the green building in Malaysia.

(Retrieved from: MGBC, 2017)

2.2.4 Problems of Green Initiative Implementation in Malaysian Firms

Hajikhani et al. (2012) found that the Malaysian firms are aware of the adoption of green strategic practices but there is a gap between awareness and implementation of green practices as the firms might be in the initial learning stage of green organisation environmental programmes and initiatives. In Malaysian enterprises, External Stakeholders' Pressures has least impact on the GSCM implementation. Therefore, the firms in Malaysia need to be educated better in cooperative relationship development

with their customers, community of stakeholders and suppliers for the mutual environmental and sustainable objectives.

Although Malaysian government has put a lot of efforts by made some regional and domestic laws and concepts for example Extended Producer Responsibility for the intention to encourage GSCM adoption, unfortunately, the adoption rate is still unsatisfied and thus larger efforts from government and businesses are needed in order to promote GSCM adoption (Hajikhani et al., 2012). With the adoption of green practices, market share of the Malaysian enterprises can be increased.

The studies of GSCM in Malaysia is still limited and there is no conclusive findings yet. Some studies on GSCM initiatives in several Asian countries such as China can be referred as China may have similar market and social-cultural situation with Malaysia (Seman, 2012). However, Christmann and Taylor (2001) stated that different pressures may be faced by different businesses sectors in different countries.

While in construction industry, Zulkefli et al. (2014) mentioned that the implementation level of GSCM in Malaysian construction industry was remain at the development stage. Some of the Malaysian construction firms only implemented parts of the GSCM practices but not as a whole and such practices are mainly green purchasing, green design and green construction (Zulkefli et al., 2014). Unfortunately, the aforementioned initiatives are not being implemented completely in the construction industry as some initiatives may be implemented broadly while others may not (Rahim, Muzaffar, Yusoff, Zainon & Wang, 2014). Green purchasing initiative was frequently adopted in construction industry especially by the contractors. Although most of the players are familiar with the green purchasing practice but they

did not know it is part of the GSCM (Rahim et al., 2014). In addition, only players involve in green projects will adopt the GSCM practices in construction industry.

2.3 Background of Supply Chain Management in the Construction Field

Since the early of 1990s, the construction supply chain modelling has been widely explored. The aims of the construction supply chain management are to improve the production efficiency and reduce the project costs by finding way to transfer the manufacturing concepts to construction concept (O'Brien, Formoso, Vrijhoef & London, 2009)

In order to measure the impacts of supply chain management practices on the project performance, a mixture of a survey and the development of simulation models is used (Hatmoko & Scott, 2010). Contractor tends to reduce the costs by procuring raw materials and also using low cost sources' equipment (Minchin, Cui, Walters & Pan, 2013) due to the complication and multidimensional relationships in construction supply chain (Meng, Sun & Jones, 2011).

There are four specific characters of supply chain management in construction industry as shown in Figure 2.3.

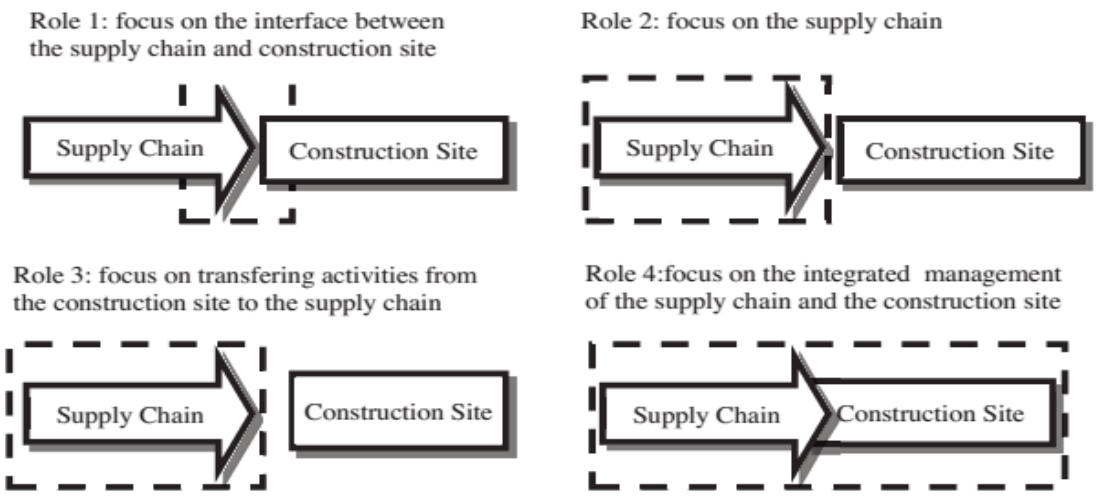

Figure 2.3 Four (4) Specific Roles of Supply Chain Management in Construction Field (Vrijhoef & Koskela, 2000)

Poor performance in construction supply chain may be caused by bad relationships among subcontractors and this will impact the SCM. In addition, absence of open and defined communication links, lack of mutual trust between parties, misalignment of project goals and lack of waste management and value added processes in the integrated supply chain also affect the performance of the project (Wibowo & Sholeh, 2015)

The supply chain in construction is complicated and the specific requirements of the end client will decide the critical level of complexity involved with the management of construction project (Cox & Ireland, 2002). In construction industry, the exact number of essential supply chains that require to be incorporated into a typical project are difficult to be quantified. For example, there may have a lot of sub-supply chains in the main construction supply chain, such as supply chains of materials supply, supply chains of labour supply and supply chains of equipment supply (Cox &